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ABSTRACT

This paper is a critique of the utility of Bidwell and Kasarda's "socio-ecological" model of school district-level academic achievement. The paper is considered to show that this model is seriously misspecified due to its omission of aggregate levels of academic ability. Based on achievement test data from the 24 school district of the state of Maryland, the report finds that estimates of the influences of community resources and organizational characteristics of districts are markedly inflated due to the omission of aggregate levels of student ability from the analysis. One 5-10 percent of the total variance in student achievement in Marylard is estimated to lie between school districts. This figure establishes an upper bound on the importance of any and all district-level variables for academic achievement. These findings are held to seriously undermine the utility of the Bidwell-Kasarda model of school district-level academic achievement. It is asserted that specific results cannot be generalized for any other State because of the small number of school districts in Maryland and the fact that districts are coterminous with county boundaries. (Author/AM)

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SCHOOL DISTRICT EFFECTS ON ACADEMIC ACHIEVEMENT: A RECONSIDERATION

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Introductory Statement

The Center for Social Organization of Schools has two primary objectives: to develop a scientific knowledge of how schools affect their students, and to use this knowledge to develop better school practices and organization.

The Center works through three programs to achieve its objectives. The Schools and Maturity program is studying the effects of school, family, and peer group experiences on the development of attitudes consistent with psychosocial maturity. The objectives are to formulate, assess, and research important educational goals other than traditional academic achievement. The program has developed the Psychosocial Maturity (PSM) Inventory for the assessment of adolescent social, individual, and interpersonal adequacy. The School Organization program is currently concerned with authority-control structures, task structures, reward systems, and peer group processes in schools. It has produced a large-scale study of the effects of open schools, has developed the Teams-Games-Tournament (TGT) instructional process for teaching various subjects in elementary and secondary schools, and has produced a computerized system for school-wide attendance monitoring. The Careers program (formerly Careers and Curricula) bases its work upon a theory of career development. It has developed a self-administered vocational guidance device and a self-directed career program to promote vocational development and to foster satisfying curricular decisions for high school, college, and adult populations.

This report, published by the School Organization Program, presents a study of the effects of school district organization on student academic achievement.

Abstract

In a recent article, Bidwell and Kasarda developed a "social-ecological" model of school district-level academic achievement. Their results, based on data from 104 Colorado school districts, suggested that various attributes of the district population and the organizational structure and staff composition of the school district do significantly affect aggregate levels of student achievement. This paper demonstrates, however, that the Bidwell-Kasarda achievement model is seriously misspecified due to its omission of aggregate levels of academic ability. Based upon achievement test data from the twenty-four school districts, and the primary and middle within them, of the state of Maryland, we find that estimates of the influence of community resources and organizational characteristics of districts are markedly inflated due the omission of aggregate levels of student ability from the analysis. Moreover, we estimate that only 5 to 10 percent of the total variance in student achievement in Maryland lies between school districts. This figure establishes an upper bound on the importance of any and all district-level variables for academic achievement. These findings seriously undermine the utility of the Bidwell-Kasarda model of district-level academic achievement.

School District Effects on Academic Achievement:
A Reconsideration

Bidwell and Kasarda (1975) have recently suggested that various organizational attributes of school districts, unlike those of schools which generally have been found of negligible importance, might be instrumental in promoting or retarding student achievement. Their model of school district effectiveness, informed by a social-ecological approach to organizational analysis, hypothesizes that properties of school districts should mediate the relationships between community inputs to the educational system and the outputs of the schooling process, especially academic achievement. Thus, the social organization of schooling is thought to transform environmental inputs into educational outputs. Bidwell and Kasarda consider the fiscal resources available to the district and various attributes of the population and clientele which it serves as salient features of the district's environment. These "environmental conditions" indirectly affect aggregate levels of student achievement through their implications for district organization, primarily its structure and staff composition.

Bidwell and Kasarda's analysis of data from 104 Colorado school districts is largely supportive of their conjecture. Employing district-level reading and math achievement as schooling outputs, they obtain:

1. Substantial proportions of explained variance for each domain of achievement.

2. Significant total effects for both environmental and district variables upon each achievement outcome.

3. Generally significant direct effects of environmental factors upon district characteristics.

4. Generally negligible direct environmental effects upon achievement in the structural model, in which district variables mediate between inputs and outputs.

Based on these results, Bidwell and Kasarda (1975: 68-69) conclude that their work "provides substantial evidence of the significance of organizational structure and staffing for school district effectiveness;" that certain of their effects, especially those of staff qualifications, are more substantial than those typically obtained at the school level; and that the conclusion from previous research that educational resources are of little consequence for student achievement"...reflects a failure to examine dependencies among environmental and organizational properties of school districts and the consequences for student achievement of these dependencies."

In view of the policy implications drawn from their analysis, the quality of Bidwell and Kasarda's inferences merits careful consideration. Unfortunately, their striking conclusions are not borne out by their own analysis and would find even less substantiation were a more adequate model of academic achievement evaluated. We will demonstrate below that their analysis and interpretation are seriously deficient in several respects. It should be noted, however, that our critique will speak only to the utility of their framework as a model of academic achievement and not to its value for exploring other environmental-organizational dependencies.

First, with regard to interpretation, Bidwell and Kasarda substantially exaggerate the practical importance of their results. Moreover, their evaluation of the import of their inquiry relative to previous research at the school level is in error. We suspect that these difficulties arise from their failure to complement the "social-ecological" approach to organizational functioning underlying their analysis with an equally cogent theory of academic performance. Any such theory would compel recognition of the fact that academic achievement is first and foremost an attribute of individual students, which recognition must bear upon the assessment of Bidwell and Kasarda's model of the achievement process.

Their disclaimer (1975:63) that consistent use of aggregate level variables obviates problems of interpretation in research on the impact of institutions notwithstanding, it must be appreciated that their analysis deals exclusively with the variance in student academic achievement that lies between school districts. That the proportions of between-school variance in educational outcomes establish upper-bounds on the extent to which any and all school-to-school differences may affect these outcomes has repeatedly been noted in the school effects literature, most systematically in Hauser's (1972) exposition of the statistical model of analysis of covariance and its utility for the study of institutional impact. Similar limits on organizational efficacy apply at the district level as well.

Indeed, the variance in student achievement lying between districts quite probably would be substantially less than that lying between schools. Were data available at three levels of analysis (student, school, and district), the variance in achievement test data could be partitioned into three additive components: within-school variance; between-school, within-district variance; and between-district variance. The bulk of the variance in every student outcome studied to date has been situated within, rather than between, schools. The Bidwell-Kasarda model further decomposes the already small portion of achievement variance lying between schools into its within and between district components and selects the latter for consideration. No evidence is provided that this portion of the variance in student achievement is sufficiently large to even warrant serious attention.

Thus, Bidwell and Kasarda's "impressive" multiple R's (.497 for reading achievement and .494 for math) pertain not to the total achievement variance, but to the variance in school district levels of achievement. A more proper interpretation of these findings would take into consideration the extent to which achievement variance is captured in differences from district to district. We

will return to this point in the discussion of our own data analysis.

The assertion that similarly impressive results have not been obtained in school-level analyses is simply incorrect. A number of the school-level inquiries reported in the Mosteller-Moynihan volume (1972) cited by Bidwell and Kasarda obtain coefficients of determination far in excess of theirs (see, for example, Smith, 1972:258-259) and "significant" regression parameters, but these are understood to apply only to the between-school variance in the outcome under consideration and are interpreted accordingly. Bidwell and Kasarda's failure to similarly appreciate the limits of their own inquiry could result in an unfortunate misunderstanding, and perhaps misuse, of their findings. Of course, much of the school effects literature is similarly deficient in this regard.

Second, the specific parameters of causal interdependency estimated by Bidwell and Kasarda are suspect due to the omission of student academic ability from their analysis. Although they acknowledge the tentativeness of their results because of this, they nevertheless fail to assess the likely implications of such misspecification (see Deegan, 1974, Goldberger, 1973, and Duncan, 1975, for general discussions of specification bias in structural equation models and Hannan, Young, and Nielsen, 1975, for a consideration of such biases in aggregated data). Academic ability has consistently been identified as the strongest measured determinant of academic performance at the individual level, and there is no reason to expect otherwise at other levels of analysis. Indeed, its omission from aggregate level research might have especially severe consequences, since extremes of collinearity are likely in highly aggregated data (see Blalock, 1964, and Hannan, 1971, for a discussion of the conditions under which this is likely to occur). Any model of academic achievement which neglects

the role of student ability will necessarily generate biased effect parameters, regardless of the level or levels at which the analysis is cast. At the district level the bias may be so pronounced as to make the exercise essentially valueless. We suspect this to be the case for the Bidwell-Kasarda analysis.

The substantive implications of the above criticisms will be documented with achievement test data from the twenty-four school districts, and the primary and middle schools within them, of the state of Maryland. Although we are unable to reproduce exactly the model evaluated by Bidwell and Kasarda and our specific results would likely not generalize to any other population, the import of our analysis for their conclusions should nevertheless be clear. The mathematics, reading, and vocabularly subtests of the Iowa Test of Basic Skills will be analyzed separately for grades 3, 5, 7, and 9. Our model of school district effectiveness is presented schematically in Figure 1.

Figure 1 about here

Following Bidwell and Kasarda, we treat community and student characteristics as exogenous to the system. Our measures of community wealth, educational level of the young adult population, community income, percent disadvantaged, percent nonwhite, and enrollment parallel, at least conceptually if not operationally, the corresponding "inputs" to the Bidwell-Kasarda model. Two intervening district organizational variables appear next in the model, percent of staff with advanced

degrees and pupil-teacher ratio. These too correspond reasonably well to variables employed by Bidwell and Kasarda; however, we lack data comparable to theirs on "professional support component" and "administrative intensity." Were an exact replication of their analysis our intention, these would be rather serious omissions; however, we judge the similarity of the two models to be quite sufficient in view of our present objectives. Indeed, we have considered a substantial number of additional intervening variables within the context of this model (including measures of teacher and principal experience and salary levels and of instructional costs) and none affect our general conclusions. The model diagrammed is the closest approximation of Bidwell and Kasarda's possible with the Maryland data.

Methodology

All data to be analyzed here were obtained through the 1973-1974 Maryland Accountability Project, mandated by the state legislature, and other State Department of Education publications (1974). Coverage was comprehensive for all twenty-four school districts and primary and middle schools in the state of Maryland. Since a detailed description of the project is available elsewhere (Maryland State Department of Education, 1975), we will limit ourselves here to a brief description of variable measurement.

1. Academic Achievement.

Three dimensions of academic achievement, all derived from the Iowa Tests of Basic Skills (ITBS), are measured by mean grade equivalence scores: Vocabulary, Reading Comprehension, and Mathematics Skills. The last combines mathematical concepts and mathematics problem solving.

2. Academic Ability (IQ) is assessed by the Cognitive Abilities Test. This ability test "does not require the ability to read or to do arithmetical computations.

It involves neither words nor numbers. The test emphasizes the discovery of and flexibility in manipulating relationships expressed in figures, symbols, and patterns" (Maryland State Department of Education, 1975:A-2).

3. Organizational properties of the school district are:

   (a) pupil-staff ratio (PT Ratio)

   (b) percent of staff with master's degree or above (Qualif). "Staff" is defined as school level administrative staff, teachers, guidance counselors, librarians, and therapists.

4. Ecological properties of the school district or school community are:

   (a) percent nonwhite (%Nonwh)- percent of the district enrollment which is Oriental, black, or American Indian. These data are not available at the school level.

   (b) Wealth per pupil (Wealth) - assessed property valuation per pupil. These data are not available at the school level. For the school-level analysis, we substitute median family income (Inc) of the area served by the school as a measure of community resources.

   (c) percent disadvantaged (% Disadv) - percent of total enrollment of children living in a household with either (1) more than one person per room, or (2) a monthly rental of $70 or less, or (3) a home with an assessed taxable base of $10,000 or less. These data are not available at the school level.

   (d) median educational level of males 25 years of age or older (Educ).

   (e) enrollment (Enroll) - total district (or school) enrollment.

Except where noted, parallel measures are available at both the district and school levels.

Following Bidwell and Kasarda, ordinary least squares regression will be employed to estimate the parameters of our simple recursive models.

Results

As noted above, Bidwell and Kasarda's district-level analysis deals only with the proportion of the between-school variance in student academic achievement that also lies between school districts. Table 1 presents those proportions for the 24 Maryland school districts for each of the achievement outcomes separately by grade. From 47 to 64 percent of the between-school variance in the three achievement tests also lies between districts. Although we have no direct data on the total achievement variance lying between Maryland schools, we might assume, based on the findings of Hauser (1972), Coleman-Campbell, et al (1966) and others, that this would be on the order of 10-20 percent. If so, then roughly 5 to 10 percent of the total variance in student achievement outcomes lies between school districts in these data. It is this variance that is analyzed in our district-level achievement model. While these figures are actually larger than we had anticipated, they nevertheless are quite modest and establish an upper bound on the importance of district-level variables for academic achievement.

Table 1 about here

The standardized estimates of the structural equations for each district-level achievement subtest are presented, by grade, in Table 2. These estimates are derived from two alternative specifications of the achievement model, first with IQ omitted (first row of each pair) and then with IQ included (second row of each pair). Thus, comparison of row 2 with row 1 will indicate the degree of bias in the estimates of district ecological and organization effects on achievement due to the omission of academic ability from the achievement equations.

Although Bidwell and Karsada were also concerned with the effects of community "resources" on district organization (PT Ratio and Qualif) these equations are not presented here due to considerations of space. We should note, though, that the dependency of district organizational properties on ecological characteristics of the districts was but modestly affected by the omission of IQ in the Maryland data. Our results are quite otherwise for the achievement subtests, however.

Table 2 about here

The results presented in Table 2 indicate that for three of the four grade levels (grades 3, 5, and 9) the exclusion of IQ results in substantially biased estimates of the influence of most district "resources" and organizational variables on all achievement outcomes. For example, for the third, fifth, and ninth grades, the deleterious effect of large pupil-staff ratios is reduced from 24 to 83 percent of its value in the misspecified version depending on the specific achievement outcome and grade level. Also noteworthy is the substantive unimportance of percent nonwhite on achievement in the properly specified equations. In the absence of controls for IQ, however, this variable registers large and significant depressant effects on achievement. Moreover, the signs associated with several variables (i.e., % Nonwh, Educ) often change after controlling for IQ. We also note that, with the exception of the seventh grade, IQ is the most influential determinant of all dimensions of achievement at all grade levels. The consistency of these results across all achievement subtests and three grade levels demonstrates the crucial importance of IQ for the determination of achievement, as well as for the estimation of unbiased effect parameters for other district "resources" and organizational properties.

The coefficients of determination presented in Table 2 indicate that most

of the between-school, between-district variance in academic achievement is explained by our district-level model. We must emphasize, however, that this represents only about 70-80 percent of the 5 or 10 percent of the total achievement variance that is likely situated between school districts. Our rather "powerful" models must be interpreted in this light. Similarly,Bidwell and Kasarda's ability to account for 25 percent of their between-district achievement variance is hardly as startling as their interpretation implies.

Individual regression coefficients presented in Table 2 should be interpreted with some caution due to the extremely small number of data points and the severe collinearity among regressors (see Farrar and Glauber, 1967, and Gordon, 1968). More stable estimates of the achievement-related efficacy of environmental inputs and staff organization are shown in Table 3, which presents the standardized coefficients of our school-level equations. These equations generally parallel those at the district level except that income is substituted for wealth and percent nonwhite and percent disadvantaged are excluded due to the unavailability of such data at the school level. These omissions are not particularly serious in view of our limited objectives.

Table 3 here

The results at the school level are quite consistent with those obtained at the district level. That is, effects of the schools' environmental resources and staffing procedures on achievement are substantially biased upward without controls for IQ; and, IQ registers by far the largest direct impact on school-level achievement. These results hold for <u>all</u> achievement outcomes at <u>all</u> grade levels. Furthermore, contrary to Bidwell and Kasarda's (1975:69) assertion that staff qualifications have not been found influential at the school level, for

grades 7 and 9 Qualif significantly enhances school-level achievement in those equations which omit IQ. These reasonably large staff effects are artifactual, however, and are obtained only because of the misspecification of the school-level achievement model.

We note once again the very large coefficients of determination for all equations, on the order of .8-.9. Thus we can "account for" most of the between-school variance in achievement. Again, however, this likely represents only 10 to 20 percent of the total variance in student achievement. Compare these results with Bidwell and Kasarda's claims regarding the relative power and implications of school and district-level analyses.

Although an exact replication of Bidwell and Karsada's model was not possible with the Maryland data, Tables 2 and 3 strongly support our general contention presented in some detail above: interpretations of district- or school-level academic achievement which exclude perhaps the most important environmental "input", student academic ability, are, at best, incomplete, and in all probability quite misleading. We are not arguing, of course, that other district- or school-level ecological or organizational variables have no influence on student achievement, but, rather, that proper assessments of such effects require careful controls for academic ability, or, more generally, an appropriately specified model. While it would be informative to also evaluate a parallel model at the individual level, such data unfortunately were not available for analysis.

Discussion

Although the consistency of these results for the State of Maryland across levels of analysis, achievement outcomes, and grade levels is quite impressive, it must be acknowledged that these specific results might not generalize to any other state. Due to the small number of school districts in Maryland and the fact that these districts are coterminous with county boundaries, Maryland's school district organization may be somewhat unusual. Therefore, we could not claim that precisely the same degrees of bias and comparability across levels of analysis would maintain for the Colorado data.

Nevertheless, the Bidwell-Kasarda achievement model identifies the state as the relevant population of interest and the school district as the pertinent unit of analysis. Our findings for Maryland suggest that their model is misspecified by the omission of student academic ability and that the consequences of this misspecification are quite serious. We expect that these conclusions would hold for Colorado as well.

We note, finally, that even the results of "correctly" specified school- or district-level achievement models must be interpreted in light of the very small proportions of total achievement variance that generally lie between schools or districts. Otherwise, conclusions concerning the efficacy of public intervention in the staffing and organization of educational institutions might be quite misleading.

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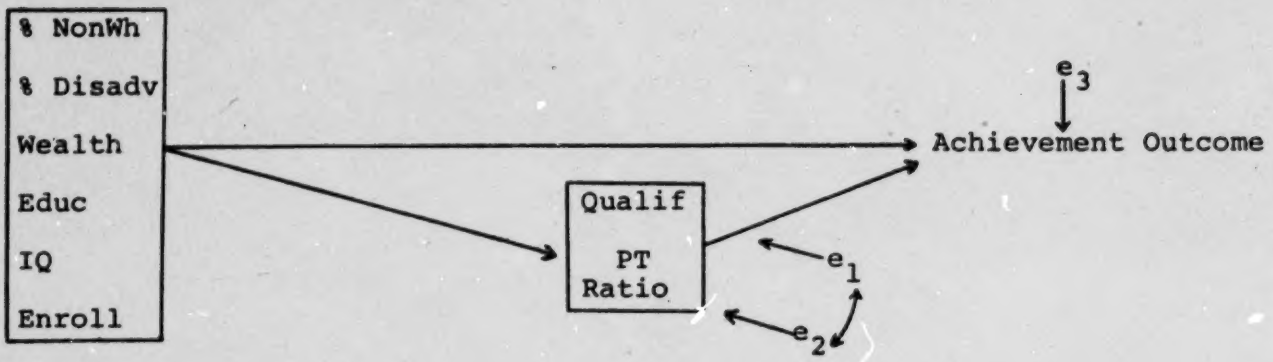
Figure 1

The Maryland Model of School-District Effectiveness*



*See text for variable abbreviations. Variables have been blocked for ease of presentation. The model is actually fully recursive, with correlated residuals as indicated, and has been estimated accordingly. All exogenous variables should also be intercorrelated.

Table 1. Proportion of Between-School Variance in Achievement Subtests Lying Between Districts, by Grade (N=24)

	Vocab	Read	Math
Grade 3	.491	.471	.468
Grade 5	.496	.493	.470
Grade 7	.617	.639	.631
Grade 9	.547	.580	.530

Table 2. Standardized Regression Coefficients For District-Level Analysis (N=24)

	Independent Variables									
	IQ	%Nonwh	Wealth	%Disadv.	Educ	Enroll	Qualif	PT Ratio	R^2	$\bar{R}^2$[a]
Grade 3										
(1) Vocabulary	-	-.378	-.017	-.356	.145	-.135	.145	-.356*	.732	(.615)
(2) Vocabulary	.775*	.028	-.105	-.170	-.082	-.056	.086	-.213	.792	(.681)
(1) Reading	-	-.399*	-.052	-.328	.136	-.223	.194	-.359*	.746	(.635)
(2) Reading	.647	-.060	-.125	-.173	-.053	-.157	.145	-.239	.788	(.675)
(1) Math	-	-.483*	-.206	-.081	.180	-.089	.224	-.536*	.722	(.600)
(2) Math	.682	-.126	-.283	.083	-.020	-.020	.171	-.410	.768	(.644)
Grade 5										
(1) Vocabulary	-	-.407*	-.015	-.328	.305	-.107	.066	-.272	.808	(.724)
(2) Vocabulary	.839*	.165	-.140	-.348*	-.015	-.061	.049	-.161	.883	(.821)
(1) Reading	-	-.557*	.012	-.335*	.215	-.099	.009	-.242	.863	(.803)
(2) Reading	.842*	.018	-.113	-.354*	-.107	-.053	-.008	-.130	.938	(.905)
(1) Math	-	-.615*	-.131	-.061	.207	.009	.127	-.278	.731	(.613)
(2) Math	1.041*	.094	-.286	-.085	-.190	.065	.107	-.140	.846	(.764)
Grade 7										
(1) Vocabulary	-	-.441*	-.055	-.240	.171	-.135	.226	-.232	.726	(.606)
(2) Vocabulary	.151	-.330	-.078	-.246	.108	-.145	.235	-.222	.728	(.583)
(1) Reading	-	-.558*	.028	-.291	.265	-.144	-.012	-.240	.848	(.782)
(2) Reading	.261	-.367	-.012	-.302	.156	-.162	.003	-.224	.853	(.775)
(1) Math	-	-.649*	-.255	-.106	.153	.054	.113	-.410*	.786	(.692)
(2) Math	-.175	-.778*	-.228	-.098	.226	.066	.103	-.421*	.788	(.675)
Grade 9										
(1) Vocabulary	-	-.507*	-.074	-.210	.135	-.011	.179	-.302	.737	(.622)
(2) Vocabulary	1.085*	.350	-.062	-.260	-.271	-.072	.282	-.052	.895	(.839)
(1) Reading	-	-.630*	.001	-.253	.106	-.121	.051	-.318*	.830	(.756)
(2) Reading	.908*	.088	.011	-.295*	-.234	-.172	.138	-.108	.942	(.911)
(1) Math	-	-.706*	-.189	-.069	.135	.124	.012	-.394*	.726	(.606)
(2) Math	1.033*	.110	-.177	-.117	-.252	.066	.111	-.156	.870	(.801)

*Coefficient at least twice its standard error.

a) $\bar{R}^2$ is the coefficient of determination adjusted for the degrees of freedom. $\bar{R}^2 = R^2 - \frac{K}{N-K-1}(1-R^2)$, where K is the number of regressors in the equation and N is the sample size (see Bohrnstedt and Carter, 1971).

Table 3. Standardized Regression Coefficients for School-Level Analysis

		Independent Variables						
		IQ	Inc	Educ	Enroll	Qualif	PT Ratio	R^2
				Grade 3 (N=887)				
(1)	Vocabulary	-	.406*	.281*	-.092*	.064*	-.042	.500
(2)	Vocabulary	.767*	.064*	.087*	-.024	.009	.013	.775
(1)	Reading	-	.368*	.286*	-.114*	.065*	-.028	.459
(2)	Reading	.822*	.003	.078*	-.042*	.007	.031	.773
(1)	Math	-	.422*	.232*	-.079*	.093*	-.048	.481
(2)	Math	.82?*	.057*	.024	-.006	.034	.011	.796
				Grade 5 (N=863)				
(1)	Vocabulary	-	.479*	.300*	-.069*	.040	-.007	.593
(2)	Vocabulary	.679*	.204*	.110*	.005	-.017	.024	.813
(1)	Reading	-	.413*	.334*	-.104*	.036	-.007	.555
(2)	Reading	.754*	.108*	.123*	-.023	-.027	.028	.826
(1)	Math	-	.485*	.213*	-.082*	.033*	.009	.519
(2)	Math	.803*	.160*	-.011	.005	.016	.046*	.826
				Grade 7 (N=230)				
(1)	Vocabulary	-	.456*	.200*	-.216*	.290*	.232*	.602
(2)	Vocabulary	.765*	.176*	-.073	-.084*	.107*	.080*	.814
(1)	Reading	-	.472*	.211*	-.256*	.239*	.216*	.598
(2)	Reading	.837*	.165*	-.087	-.112*	.039	.050	.852
(1)	Math	-	.585*	.066	-.250*	.283*	.252*	.603
(2)	Math	.844*	.275*	-.234*	-.105*	.081*	.084*	.861
				Grade 9 (N=222)				
(1)	Vocabulary	-	.423*	.266*	-.018	.238*	.105*	.618
(2)	Vocabulary	.763*	.119*	.053	.032	.051	-.107*	.848
(1)	Reading	-	.435*	.177*	-.081	.271*	.212*	.540
(2)	Reading	.910*	.073	-.078	-.021	.048	-.040	.868
(1)	Math	-	.504*	.149*	-.067	.251*	.245*	.575
(2)	Math	.878*	.154*	-.097*	-.011	.036	.001	.881

*Coefficient at least twice it's standard error.